EXPERIMENT 3: UNIFORMLY ACCELERATED MOTION

PURPOSE:
Analyze and describe motion with a constant acceleration.

MATERIALS:
2m ramp (for example the dynamics aluminum track from pasco ME-9779), steel ball, stop watch, wooden block (optional), plot.ly (or other spreadsheet)

DATE________________

AUTHOR____

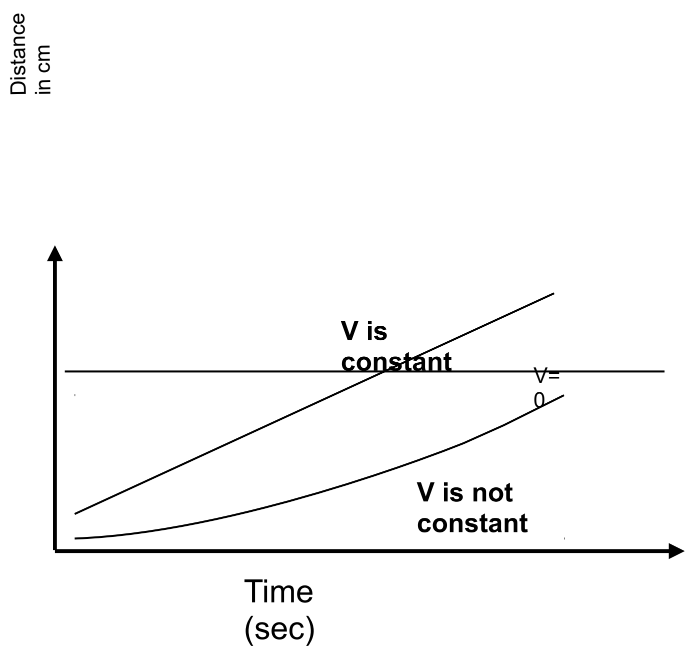
PARTNER____

PARTNER____

BACKGROUND

In this lab, you will analyze and describe motion a non constant velocity but constant acceleration.

Figure below compare the distance versus time for motion with a constant velocity, with a non constant velocity, and with no velocity at all. Can you tell which one is which ?

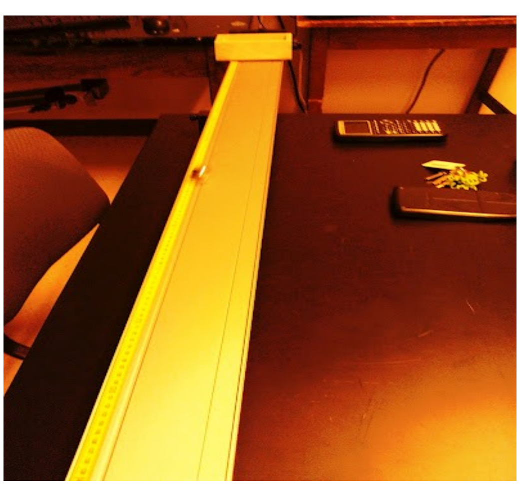


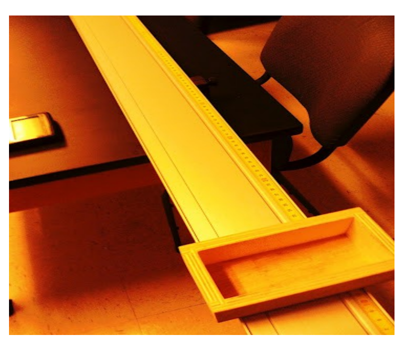
Note that the slope for some object not moving will be a straight line. If a vehicle is moving at a uniform (constant) velocity the line will have a positive slope. This slope will describe the magnitude of the velocity, sometimes referred as the speed. The line for a vehicle moving at a non constant speed is also known as accelerated motion, on the other hand, will be non constant. A non constant speed is also known as an accelerated motion, and the ratio of how fast the motion is changing per unit of time is called acceleration.

Taking measurable data from a multitude of sense impressions, finding order in the data, then inventing a concept to describe the order are the activities of science.

PROCEDURE

1. You will now set up a track for collecting data for a car going down hill. Gravity pulls the car down but gravity is diluted. The track has to be at least 2 m long and supported somewhere between 10 and 50cm above the table.





2. Place the block at the end of the track. At he mark 220cm for example. Make sure it stays there.
3. Place the ball 40cm above the block and hold it with a ruler. With a stop watch measure the time it takes the ball to hit the block. Record in TABLE 1. repeat 5 more times. Record in TABLE 1.
4. Repeat for a distance of 80cm from the block. And record in TABLE 1.
5. Repeat for more locations. 120cm. 160cm. 180cm. 200cm.
6.

TABLE 1

Distance from bottom (cm)	**Time trial 1 (s)**	**Time trial 2 (s)**	**Time trial 3 (s)**	**Time trial 4 (s)**	**Time trial 5 (s)**	**Time trial 6 (s)**	**Time Average (s)**
0	0	0	0	0	0	0	0
40							
80							
120							
160							
180							
200							

ANALYSIS

1) For each row of **TABLE1** average the time. Report the average time and the distance in the table below.

Use only the two first columns. Don't worry about the last three column for now.

TABLE 2

Average time (s) = x-axis	**Distance from bottom (cm) y-axis**	**Average speed (cm/s)**	**Final speed (cm/s)**	**Acceleration (cm/s/s)**
0	0	------	0	-------

2)

step 1: Use plot.ly on line (or another spreadsheet) and make a scatter plot of ***distance (y) versus time (x)***. Don't connect the dots.

Include point (0,0). What is this graph called? (Line ? Parabola ? Sine ?)

step 2: Use the spreadsheet to fit the scatter plot with a quadratic equation (parabola).

Display the equation on your graph.

You get the equation: distance = ______ time^2 (or y = ___ x^2 with y the distance and x the time)

What is the coefficient you get in front of the x^2 (or time^2)? ___________

step3: Multiply this coefficient by 2 : a =_______ cm/s/s/. According to the kinematics equation this number is the acceleration of the ball.

We will compute this acceleration 2 different ways to see if every thing is consistent.

Step4: Copy and paste the graph below or attach the graph to your lab report.

3) You can use the equation of kinematics for an object uniformly accelerated (constant acceleration) to compute the acceleration of the car and the final speed.

Step1: For each distance compute the average velocity using this formula:

Average speed = distance covered / time. Record in **TABLE 2**

Step2: For each distance, compute the final velocity (the speed the ball has before hitting the block)

Final speed = 2 x (average speed). Record computations in **TABLE 2.**

This is because average speed = (initial speed + final speed) / 2 if the acceleration is constant and since initial speed = 0 then average speed = final speed / 2

Step3: For each distance, compute the acceleration using:

acceleration = final speed / time. Record in **TABLE 2**.

This is because final speed = acceleration x time

4) Use the **TABLE 2**.

Is the acceleration of the car constant ? (if the measurements were done properly, the acceleration should be about constant. Every second the speed increases by the same amount).

The acceleration of the ball is about ______ cm/s/s (compute the average) . Meaning every second, the ball gets faster by ______.

Is this number about the same as the one found in 2 ? ___________

5) With the spreadsheet again. Use a new grid and go back to the **TABLE 2**.

Step1: make a scatter plot of ***final speed (y-axis) versus time (x-axis)*** . Include the point (0,0)

Step2: Fit the data with a linear equation. Display equation on the graph.

Velocity = _____ . time (or y = ____ x) so Slope = _______ cm/s/s

The slope is the ____________________ of the car. Do you get the same value as in 2 and 3 ?

The acceleration of your ball is about _______ cm/s/s

Copy and paste the graph below or attach it to your lab report.

6) Explain the difference between speed and acceleration. What are the units ?

7) When an object accelerated at a constant rate. The graph distance vs time is a line ? Parabola ?

But the graph velocity vs time is a ___________.

8) describe the 3 ways you computed the constant acceleration.

- graphically with *distance vs time*

- using kinematics equations

- graphically using *velocity vs time*

CONCLUSION:

Was the purpose of this lab accomplished ? Why or Why not ?

(your answer to this question should show thoughtful analysis and careful, through thinking)